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Seed Vigour of Parental Lines and its Hybrid in Maize (*Zea mays* L.)

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A B S T R A C T

Two hybrids of maize (*Zea mays* L.) and its parental lines were studies for seed vigour. The seed materials consist of two maize hybrids SHM-1 and DHM-117 and its parental line VQL-1 and SML-1; and BML-6 and BML-7 respectively were collected from Rabi 2016-17 harvest. The seed were tested for initial vigour parameters and subjected to seed treatment with fungicide, insecticide and combination of both. The storage studies were conducted on these treated seed by packing in muslin cloth bag and placing it for six month storage under ambient conditions. The seed lots were evaluated for germination (%), seedling length (cm), seedling dry weight (mg) and vigour index I and II. It was found that the seed deterioration of hybrids were significantly slower than its parental line and treatment with thiram (75 % WS, 2g/kg of seed) improved the storability better than other treatment.

Introduction

Maize is one of the most important cereal crops in the world agricultural economy both as food for man and feed for animal. In Indian Agriculture, Maize occupies a prominent position and each part of the maize plant is put to one or the other use and nothing goes as waste. Maize as a crop has multiple uses but it is chiefly grown for human and livestock consumption. Seeds are required to be kept in safe storage since they are harvested in the preceding season and usually used for sowing in the subsequent season after a time gap of six months or longer. Thus, proper storage is required to keep seeds in good condition. The storability of seed is greatly affected by genetic and environmental factors. Seed lot of a given kind, variety, chronological age and germination do not maintain viability equally well in storage under identical conditions. Marshal and Levis (2004) demonstrated that various factors such as weather conditions during seed producing stage, pests and diseases, seed oil and moisture content, mechanical damages, storage time and relative humidity of store can affect vigour of seeds. Seed vigour is the sum total of all those properties, which determine the potential level of activity and performance of seed or seed lot during germination and seedling emergence (Perry, 1978). High vigour seed will reduce seed rate for sowing and still maintains adequate crop for good yield. Egal *et al.* (2005) reported that fungal growth in maize is facilitated by hot and humid conditions. Despite maize seed being a good storer, maintenance of high germination standard for quality seed under storage is difficult under ambient condition in Bihar. Keeping in view of above fact, the present investigation had planned.

Materials and Methods

The research material consists of six lots of maize varieties such as BML-6, BML-7, DHM-117, VQL-1, SML-1 and SHM-1 were collected and dried upto 12 per cent seed moisture content. All seed lot were treated with fungicide (Thiram 75 %WS, 2gm/kg seed), Insecticide (Imidacloropid 17.8% SL, 2ml/kg seed) and combination of them and then packed in muslin cloth for storage upto six months i.e., September-2017 to February-2018, under ambient conditions. Then, the seed quality parameters were recorded at three-month interval. For seed germination (%), eight replicates of 50 seed of each variety and also of each treatment was tested for germination studies as per ISTA (2015) method. In this method, seed were placed between two layer of wet germination paper which was then rolled and wrapped in wax sheet and placed in germinator in an upright position under 20 ± 1^{o}C and 95 % RH for 14 days. On the day of final count i.e., 14th day, it was evaluated for normal seedling, abnormal seedling, dead and hard seed. Ten normal seedlings were selected, randomly from each replication and shoot and root length were averaged for total seedling length (cm).Then, ten normal seedlings were also selected randomly from each replication for seedling dry weight (mg) which were dried in hot air oven, maintained at 70 ± 1^{o}C for 48 hour and cooled in desiccator.

The vigour indices were calculated by adopting the formula (AbdulBaki and Anderson 1973); Vigour Index I=Germination (%) × Seedling Length (cm) and Vigour Index II=Germination (%) × Seedling Dry Weight (mg)

Results and Discussion

The initial seed quality parameter of six varieties of maize seed lots revealed that all the varieties had more than 80 per cent seed germination (table 1). There was significantly higher standard germination (>90%) in hybrids such as DHM-117 (91%) and SHM-1 (93.67%); however, there is no significant difference in germination per cent of parental lines of both hybrids.

Table.1 Initial Seed Quality Parameters of Maize Varieties

Varieties	Germination (%)	Seedling Length (cm)	Seedling Dry Weight (mg)	Vigour Index- I	Vigour Index-II
BML-6	81.67	19.50	91.65	1593	7485
BML-7	83.00	20.33	95.57	1687	7930
DHM-117	91.00	21.73	102.15	1978	9297
VQL-1	85.67	20.07	94.31	1719	8081
SML-1	86.00	22.00	103.40	1893	8896
SHM-1	93.67	24.07	113.11	2254	10593
CD (0.01)	**2.508**	**1.160**	**5.221**	**102.499**	**461.253**
CV (%)	**1.681**	**3.410**	**3.410**	**3.622**	**3.622**

Table.2 Effect of Treatment on Germination (%) of Varieties after 0, 3 and 6 Months of Storage

Varieties	Seed germination (%)														
	0 MoS					3 MoS					6 MoS				
	T0	T1	T2	T3	Mean(V)	T0	T1	T2	T3	Mean(V)	T0	T1	T2	T3	Mean(V)
BML-6	77.67	81.00	77.67	81.17	**79.37**	72.83	78.83	72.83	78.33	**75.70**	65.66	76.33	65.67	75.33	**70.74**
BML-7	79.17	81.67	78.67	82.33	**80.46**	74.50	79.50	74.17	79.33	**76.87**	67.16	77.83	67.33	77.33	**72.41**
DHM-117	86.67	90.67	86.83	90.83	**88.75**	80.17	86.33	81.50	85.33	**83.33**	73.00	82.33	75.00	82.16	**78.12**
VQL-1	80.17	83.33	80.33	83.83	**81.91**	75.33	80.17	75.16	80.16	**77.705**	68.00	77.83	67.83	77.83	**72.87**
SML-1	81.17	84.67	81.50	85.00	**83.08**	75.50	80.50	76.83	81.00	**78.45**	67.66	78.16	69.33	78.16	**73.32**
SHM-1	87.83	90.50	86.33	90.83	**88.87**	83.50	86.33	82.00	86.00	**84.45**	75.66	84.00	74.50	84.00	**79.54**
Mean (T)	**82.11**	**85.31**	**81.89**	**85.67**		**76.97**	**81.94**	**77.08**	**81.69**		**69.52**	**79.41**	**69.94**	**79.13**	
CD(P =0.01)															
V	**0.56**					**0.59**					**0.60**				
T	**0.46**					**0.48**					**0.49**				
V x T	**NS**					**1.19**					**1.22**				

MoS- Month of Storage, V-Variety; T- Treatment; T0-Control; T1- Thiram 75% WS @ 2g/ kg of seed; T2- Imidacloropid 17.8% SL @ 2ml/ kg of seed); T3- Thiram 75% WS @ 2g/ kg of seed + Imidacloropid 17.8% SL @ 2ml/ kg of seed)

Table.3 Effect of Treatment on Seedling Length (cm) of Varieties after 0, 3 and 6 Months of Storage

Varieties	Seedling length(cm)														
	0 MoS					3 MoS					6 MoS				
	T0	T1	T2	T3	Mean(V)	T0	T1	T2	T3	Mean(V)	T0	T1	T2	T3	Mean(V)
BML-6	18.58	20.75	19.58	20.91	**19.95**	17.28	19.41	18.36	19.36	**18.60**	14.15	16.31	16.06	16.06	**15.65**
BML-7	19.18	21.33	20.16	21.66	**20.58**	17.38	19.76	18.36	19.75	**18.81**	14.45	17.06	15.65	17.40	**16.14**
DHM-117	19.98	22.06	20.31	22.26	**21.15**	17.80	20.48	18.85	20.65	**19.44**	14.91	17.90	15.98	17.50	**16.57**
VQL-1	18.80	20.96	19.13	20.35	**19.81**	16.88	19.51	17.65	19.21	**18.31**	14.16	16.56	14.90	16.68	**15.57**
SML-1	21.21	22.55	20.26	23.88	**21.97**	20.16	21.21	80.91	21.81	**20.52**	17.00	18.33	15.88	18.85	**17.51**
SHM-1	22.83	25.56	23.83	25.53	**24.44**	21.21	23.83	21.61	23.76	**22.60**	18.25	21.41	18.40	20.85	**19.72**
Mean (T)	**20.10**	**22.20**	**20.55**	**22.43**		**18.45**	**20.70**	**18.96**	**20.76**		**15.48**	**17.93**	**16.14**	**17.89**	
CD (P=0.01)															
V	**0.50**					**0.48**					**0.42**				
T	**0.41**					**0.39**					**0.34**				
V x T	**NS**					**NS**					**0.83**				

Table.4 Effect of Treatment on Seedling Dry weight (mg) of Varieties stored for 0, 3 and 6 Months of Storage

Varieties	Seedling Dry Weight (mg)														
	0 MoS					3 MoS					6 MoS				
	T0	T1	T2	T3	Mean (V)	T0	T1	T2	T3	Mean (V)	T0	T1	T2	T3	Mean (V)
BML-6	87.34	97.52	92.04	98.30	**93.80**	81.61	91.51	86.69	91.29	**87.78**	69.76	78.20	76.66	78.20	**75.70**
BML-7	90.16	100.26	94.78	101.83	**96.76**	82.13	93.14	86.69	93.06	**88.76**	71.45	80.50	75.90	82.03	**77.47**
DHM-117	93.92	103.71	95.48	104.65	**99.44**	84.06	96.53	88.89	97.25	**91.68**	72.37	85.71	77.28	86.02	**80.34**
VQL-1	88.36	98.54	89.92	95.64	**93.11**	79.83	92.00	83.40	90.63	**86.46**	69.15	80.50	74.36	79.12	**75.78**
SML-1	99.71	105.98	95.25	112.25	**103.30**	95.02	99.86	89.21	102.64	**96.68**	82.49	87.09	76.36	90.77	**84.18**
SHM-1	107.31	120.16	112.01	120.00	**114.87**	99.91	112.05	101.75	111.69	**106.35**	87.86	101.81	89.70	99.66	**94.76**
Mean (T)	**94.47**	**104.36**	**96.58**	**105.45**		**87.09**	**97.51**	**89.44**	**97.76**		**75.51**	**85.63**	**78.37**	**85.96**	
CD(P=0.01)															
V	**2.37**					**2.33**					**2.18**				
T	**1.93**					**1.90**					**1.78**				
V x T	**NS**					**NS**					**4.37**				

Table.5 Effect of Treatment on Varieties for Vigour Index I of Varieties after 0, 3 and 6 Months of Storage

Varieties	Vigour Index I														
	0 MoS					3 MoS					6 MoS				
	T0	T1	T2	T3	Mean (V)	T0	T1	T2	T3	Mean (V)	T0	T1	T2	T3	Mean (V)
BML-6	1447.08	1684.00	1523.08	1702.00	**1589.04**	1273.75	1540.36	1349.98	1527.10	**1422.80**	972.95	1260.31	1094.36	1224.98	**1138.15**
BML-7	1522.91	1746.16	1590.08	1788.16	**1661.83**	1307.68	1580.75	1374.40	1574.61	**1459.36**	1014.20	1342.61	1095.05	1361.05	**1203.22**
DHM-117	1739.71	2004.43	1768.68	2027.60	**1885.10**	1443.76	1781.00	1550.23	1774.88	**1637.47**	1134.43	1497.55	1241.96	1463.71	**1334.41**
VQL-1	1514.20	1752.46	1539.63	1709.43	**1628.93**	1287.76	1577.95	1338.66	1554.01	**1439.60**	1009.41	1310.93	1060.41	1317.51	**1174.57**
SML-1	1726.18	1913.40	1656.31	2037.75	**1833.41**	1540.05	1719.86	1469.91	1779.01	**1627.21**	1314.68	1450.10	1139.88	1493.33	**1349.50**
SHM-1	2012.45	2317.71	2068.91	2324.83	**2180.97**	1790.91	2070.78	1792.35	2058.76	**1928.20**	1430.90	1826.93	1423.91	1777.88	**1614.90**
Mean(T)	**1660.42**	**1903.03**	**1691.12**	**1931.63**		**1440.65**	**1711.78**	**1479.25**	**1711.40**		**1146.09**	**1448.07**	**1175.93**	**1439.74**	
CD(P=0.01)															
V	**46.48**					**42.33**					**34.66**				
T	**37.95**					**34.56**					**28.30**				
V x T	**NS**					**NS**					**69.33**				

Table.6 Effect of Treatment on Varieties for Vigour Index II of Varieties after 0, 3 and 6 Months of Storage

Varieties	Vigour Index II														
	0 MoS					3 MoS					6 MoS				
	T0	T1	T2	T3	Mean (V)	T0	T1	T2	T3	Mean (V)	T0	T1	T2	T3	Mean (V)
BML-6	6801.29	7914.80	7158.49	7999.40	**7468.49**	5992.26	7246.21	6349.36	7184.62	**6693.11**	4703.55	6013.80	5156.08	5930.91	**5451.08**
BML-7	7157.70	8206.98	7473.39	8404.38	**7810.61**	6157.29	7435.57	6466.75	7405.70	**6866.33**	4917.26	6313.81	5228.60	6391.58	**5712.81**
DHM-117	8176.66	9420.83	8312.81	9529.72	**8860.00**	6792.11	8371.29	7289.05	8337.21	**7697.42**	5416.19	7125.69	5920.86	7135.57	**6399.58**
VQL-1	7116.74	8236.59	7236.27	8034.33	**7655.98**	6063.30	7416.13	6300.34	7307.98	**6771.94**	4836.08	6325.66	5172.68	6217.71	**5638.03**
SML-1	8113.06	8992.98	7784.68	9577.42	**8617.03**	7231.69	8077.46	6910.60	8349.23	**7642.24**	6343.32	6859.92	5409.22	7150.45	**6440.72**
SHM-1	9458.51	10893.27	9723.90	10926.72	**10250.60**	8402.34	9709.26	8404.10	9649.43	**9041.28**	6787.10	8630.95	6819.85	8444.58	**7670.62**
Mean (T)	**7803.99**	**8944.24**	**7948.26**	**9078.66**		**6773.17**	**8042.65**	**6953.36**	**8039.03**		**5500.58**	**6878.30**	**5617.88**	**6878.47**	
CD (P=0.01)															
V	**218.46**					**204.73**					**172.30**				
T	**178.37**					**167.16**					**140.68**				
V x T	**NS**					**NS**					**344.60**				

The highest germination percentage was recorded by SHM-1 (93.67 %) and lowest by BML-6 (81.67 %). But at 3 month and 6 months of storage, there was significant effect of seed treatment on varieties. The range of germination at 3 month and 6 months was 84.45(SHM-1) to 75.70 per cent (BML-6) and 79.54(SHM-1) to 70.74 per cent (BML-6), respectively. The highest germination per cent was reported with treatment T_1 (Thiram 75% WS, 2g/ kg of seed) and T_3 (Thiram 75% WS, 2g/ kg of seed + Imidacloropid 17.8% SL, 2ml/ kg of seed), over control during all three-storage duration. A similar result was also reported by Basu and Dadlani (2004) in maize crop.

The initial seedling length of hybrid DHM-117 and SHM-1 had significantly higher than its parental lines.SHM-1, having more seedling length than that of DHM-117. Maximum seedling length was recorded by SHM-1 (24.07cm) and minimum length by BML-6(19.50 cm). The effect of seed treatment on seedling length of varieties for three storage periods is presented in table2.The mean data of varieties for seedling length showed that each was significantly different to each other. At 0 month and 3 months, the effect of seed treatments on varieties was found non- significant, but at 6 months of storage, this was found significant. Treatments T_1 and T_3 significantly improved the seedling length of all varieties over its control (table 3). The range of seedling length was 19.92(SHM-1) to 15.57cm (VQL-1).

The seedling dry weight was recorded significantly higher for seed treatment with T_1 and T_3 over T0 (Control). It was also recorded that T_1 and T_3 was at par. At 0 month and 3 months, effect of treatment on varieties was found non- significant, but it was found significant at 6 months of storage. There was no significant difference between control and treatment with insecticide. Treatments T_1 and T_3 significantly improved the seedling dry weight of all varieties over its control (table4).The range of seedling dry weight was 94.76(SHM-1) to 75.70mg (BML-6).

Similar pattern was reported for Vigour index-I (table-5) and II(table-6) and was significantly higher for hybrid DHM-117 and SHM-1 than its parent BML-6, BML-7and VQL-1 SML-1respectively at zero months. Similar observation was also recorded at three- and six-months interval. The present findings are in accordance Malarkodi *et al.*(1999) and Mettananda (2005) in Maize.

The initial seed quality assessment revealed that there was a significant difference of seed vigour among inbred line and hybrid and the materials were diverse in nature for various parameters studied. The seed vigour index as well as storability of seed is higher for hybrid in comparison to its parental line. All the treatment improved the seed vigour potential of hybrid and its parental lines. The treatment with Thiram (75 % WS, 2g/Kg of seed improved highest for seed vigour index at all stages of seed storage study. Conclusively, this treatment improved the seed storability of hybrid and its parental line.

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